STACK PARTICULATE EMISSION TEST
44 INCH MILL SCARFER
SCRUBBER EXHAUST STACK

LTV STEEL COMPANY
CHICAGO, ILLINOIS

ARI PROJECT #460-01
LTV STEEL P.O. #48604

REPORT PREPARED FOR:

LTV STEEL COMPANY
11600 S. BURLEY AVENUE
CHICAGO, ILLINOIS 60617

REPORT PREPARED BY:

ARI ENVIRONMENTAL, INC.
600 N. FIRST BANK DRIVE
PALATINE, ILLINOIS 60067

MAY 19, 22 AND JUNE 1, 1986 TEST

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LTV STEEL COMPANY : CHICAGO, ILLINOIS

TABLE OF CONTENTS

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I. INTRODUCTION AND SUMMARY

ARI Environmental, Inc. was retained by LTV Steel Company to conduct a particulate emission test on the scrubber exhaust stack serving the 44 inch mill scarfer at the Chicago, Illinois plant on May 19, 22 and June 1, 1986.

The purpose of this test was to determine the scrubber exhaust stack particulate concentration and emission rate during the scarfing operation.

Test procedures followed, where applicable, USEPA Methods 1-5 as detailed in the Code of Federal Regulations, CFR40, dated July 1, 1985.

Testing was conducted by Mr. H. M. Taylor, Mr. J. Thomas and Mr. S. Sundberg of ARI Environmental. Also present during the test series was Mr. John Potwora of LTV Steel and Mr. Fred Smith of the Illinois Environmental Protection Agency.

This report summarizes the test procedures and results of this test series. Attached, as appendices, is a complete documentation of all field test data, calculation summary data, laboratory analysis data and test equipment calibration data sheets.

The test results indicated the following average stack particulate concentrations during the test:

Test Date	Run No.	Particulate Concentration (gr/dscf)
5-19-86	1	0.0414
5-22-86	2	0.0400
6-1-86	3	0.0530

* Average stack particulate concentration as measured during scarfing operation only with scrubber and fan operational.

II. TESTING AND ANALYTICAL PROCEDURES

Overview

ARI Environmental was retained by LTV Steel Company to conduct a particulate emission test on the scrubber exhaust stack serving the 44 inch mill scarfer at the Chicago, Illinois plant on May 19, 22 and June 1, 1986.

Methodology

Sampling was conducted for particulate concentration following, where applicable, USEPA Methods 1-5 as detailed in the Code of Federal Regulations, CFR40, dated July 1, 1985 and the Quality Assurance Handbook for Air Pollution Measurement Systems, Volume III, Stationary Source Specific Methods.

Sample Location

Sampling was conducted using the two 4 inch I.D. test ports located at two 3 inch I.D. test ports located at right angles in this 54 inch I.D. vertical stack. The test ports were located approximately 40 inches above the roof line, approximately 12 feet downstream of the nearest geometry change and approximately 8 feet upstream from the stack top.

Gas Flow and Temperature

Velocity and volume flow rate were determined following EPA Method 2 as detailed in the CFR40. Velocity and temperature readings were determined at each of 12 points on two traverses for a total of 24 points.

Velocity traverses in the stack were made with a Type "S" pitot tube. The velocity head was read on inclined manometer to the nearest 0.01 in H_2O. Temperature measurements in the stack were performed with a Chromel-Alumel thermocouple and connected to a Keithley digital direct read out potentiometer accurate to within 1% of the absolute stack temperature.

Stack Gas CO_2, O_2, CO and N_2 Content

Analysis for carbon dioxide (CO_2), oxygen (O_2), carbon monoxide (CO) and nitrogen (N_2) by difference, was performed using a Hays Orsat type gas analyzer.

Particulate Sampling Train

The particulate sampling train used during the test series was a Research Appliance Corporation Method 5 sampling train. A schem-

atic drawing of the train components is shown in Figure 2-1. The major components are described below.

1. Nozzle - Type 316 stainless steel with sharp tapered leading edge - 0.1875 inch I.D.

2. Probe - 60 inch effective length type 316 stainless steel glass lined and heated with attached pitot tube and stack temperature thermocouple.

3. Research Appliance Corporation Sample Case and Control Module - As per EPA Method 5 test specifications.

Particulate Sampling Assembly

1. A stainless steel nozzle was selected and attached to the probe.

2. A preweighed glass fiber filter was placed in the filter holder and its number noted on the data sheets.

3. 100 mls of distilled water were placed in the first and second impingers.

4. The third impinger was assembled dry.

5. 200 grams of dry silica gel were placed in the fourth impinger.

6. The entire sampling train was then assembled at the sampling location as shown in Figure 2-1.

Pretest Leak Check Procedures

Sampling Train

1. The pump was started

2. The course flow adjustment valve was opened.

3. Flow through the dry gas meter was checked.

4. The probe inlet was plugged.

5. The fine flow adjustment valve was adjusted so that the vacuum gauge read 15 in Hg. and the gas meter was observed to insure an acceptable leak check.

Pitot Tube (Pretest)

1. A positive (or negative) pressure was created in the pitot line to be checked.

2. The line was then plugged to hold the pressure, and the inclined manometer fluid level was monitored to insure that no leaks were present in the pitot line system.

Particulate Sampling Procedure

Crushed ice was added to the impinger compartment and the sample case was moved into position outside the first port to be sampled. When the filter holder assembly was properly heated, the nozzle was uncapped and the probe introduced into the stack to the first sampling point. The dry gas meter reading was recorded and sampling was started. At each point, a pitot reading was made and the sampling rate was adjusted using calculations which were based on preliminary temperature, pressure and moisture estimates. When sampling at the last point in the port was completed, the pump was turned off and the probe was carefully removed from that port.

Based upon the nature of the scarfing operation itself, sampling was conducted only during the period of actual visible stack particulate emissions. Specifically, sampling was conducted at a total of 24 stack sampling points with each point sampled during the emissions from a single scarfing operation. At each of the 24 sampling points, sampling commenced when the visible emissions first appeared at the exhaust stack exit and ended when visible emissions stopped. This sampling time for each scarf and each respective sampling point ranged from 12.0 to 43.1 seconds in duration with an average time of 24.3 seconds during the test. Sampling point start times were relatively simple to anticipate since the scrubber exhaust fans would be started approximately 12 seconds prior to the actual visible emissions. At this time, the exhaust stack gas velocity ΔP would rise from 0.20 to approximately 2.5 inches of water.

The complete test consisted of three separate sampling runs of 24 scarfs each.

At the completion of each sampling run a post test leak check was performed on the sampling train and pitot system. The umbilical cord was disconnected and the sample case and probe were then disassembled.

Particulate Sample Recovery

1. A brush and acetone were used to clean the probe and nozzle as required. The acetone washings from the inner surfaces of the nozzle and probe were collected in a bottle. This clean up was conducted on site.

2. At the laboratory, the filter was removed from the holder and placed in a clean Petri dish.

3. The contents of impingers #1, #2 and #3 were measured for final volume using a graduated cylinder.

4. The silica gel of impinger #4 was transferred to a bottle for final weighing.

Particulate Sample Analysis

1. At ARI's laboratory, the filter was placed in a dessicator, allowed to dry to a constant weight, and weighed to the nearest 0.1 mg on an analytical balance.

2. At ARI's laboratory, the nozzle, probe and prefilter glassware washings were transferred to a tared beaker and allowed to evaporate at room temperature in a fume hood. It was then placed in a desiccator, dried to a constant weight, and weighed on an analytical balance to the nearest 0.1 mg.

3. The silica gel was transferred to a tared beaker and the weight of the silica gel was determined. The difference between this final weight and 200 grams was the total moisture collected by the silica gel.

4. The net weight gain recorded for the acetone washings and the filter were summed to yield the total particulate collected.

III. TEST RESULTS AND DISCUSSION

The results of the emission test are summarized in Table III-1.

The field test data, calculation summary data and laboratory analysis data sheets are included in Appendix A.

Test equipment calibration data is included in Appendix B.

Based upon the test results and observations made during the course of the testing itself, the following comments should be made:

1.) The test results indicated average stack particulate concentrations of 0.0414, 0.0400 and 0.0530 grains/dscf for test runs #1, #2 and #3 respectively. These test runs were conducted on each of three separate days of testing including May 19, 22 and June 1, 1986. Separate days were required due to the limited number of pieces requiring scarfing each day.

2.) Since sampling was conducted only during the actual scarfing operation, stack particulate concentration and emission rate test results as detailed in Table III-1 represent the average stack concentrations and emission rates during scarfing and scrubber operation.

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LTV STEEL COMPANY : CHICAGO, ILLINOIS

SUMMARY OF STACK EMISSION TEST RESULTS

TABLE: III-1

COMPANY: LTV Steel Company : Chicago, Illinois

LOCATION: 44 Inch Mill Scarfer Scrubber Exhaust Stack

TEST DATE:	5/19/86	5/22/86	6/1/86
TEST RUN:	1	2	3
STACK GAS*			
Temperature, °f	99.7	100.8	111.4
Velocity, fps	90.3	86.0	85.6
Volume flow, acfm	86,171	82,041	81,732
Volume flow, scfm	79,389	77,067	75,024
Volume flow, dscfh	4,583,287	4,398,391	4,240,367
Moisture, % by vol	3.8	4.9	5.8
CO_2, % by vol	0.3	0.3	0.2
O_2, % by vol	20.5	20.4	20.4
PARTICULATE SAMPLE			
Time, min.	9.04	10.38	9.70
Volume, dscf	8.07	9.18	8.41
Particulate collected, mg	22.5	23.8	28.9
Isokinetic ratio, %	100.7	100.1	101.9
PARTICULATES*			
Concentration			
grains/dscf	0.0414	0.0400	0.0530
x 10^{-6} lb/dscf	5.92	5.72	7.58
Emission rate			
lbs/hr	27.14	25.15	32.13

* Average stack gas parameters and emission rates determined during scarfing operation only with scrubber and fan operational.